

CLAIMS

What is claimed is:

1. An apparatus to record data on a DVD, comprising:
an encoder to encode the data as effective data of a DVD-
Audio format in an audio title set (AUDIO_TS) of the DVD; and
an optical pickup to record the data on the DVD.

2. The apparatus as claimed in claim 1, wherein said
encoder stores said data on the DVD in a plurality of audio
streams, wherein said audio streams are linear PCM audio streams
or compression coded audio streams using a corresponding
extension algorithm.

3. An apparatus for recording data on a DVD-Audio disk,
the apparatus comprising:
an encoding unit to generate said data to be reproduced and
information on said data to be reproduced; and
an optical pickup to store said data to be reproduced in a
data zone of the DVD-Audio and to store said information on said
data to be reproduced in an information zone of the DVD-Audio,
said information zone includes directories of a video title set
(VIDEO_TS) and an audio title set (AUDIO_TS), wherein said
AUDIO_TS directory includes information on an audio manager (AMG)
having information on audio titles, wherein said data zone
includes said audio titles each having audio title set
information (ATSI) followed by a plurality of contiguous audio
objects (AOBs), said ATSI includes a plurality of audio stream
attributes each having an audio coding mode, a first, second or
third quantization bit number corresponding to the data to be

reproduced, a first, second, third, fourth, fifth or sixth sampling frequency corresponding to the data to be reproduced, and decoding algorithm information relating to a number of audio channels of the data to be reproduced, and each of said AOBs includes a plurality of audio packs recorded with audio data corresponding to the decoding algorithm stored in the audio stream attribute.

4. The apparatus as claimed in claim 3, wherein if said audio coding mode is linear pulse code modulated (PCM) audio, the encoding unit determines a maximum number of said audio channels by the following Eq. 1:

Eq. 1

$$N = \frac{Mby}{Fs * Qb},$$

wherein Fs is the sampling frequency(Hz), Qb is the quantization bit number, Mby is the maximum data transfer rate(Mbps) of the DVD-Audio disk, and N is the maximum number of said audio channels determined by the data transfer rate, sampling frequency and quantization bit number of the DVD-Audio disk.

5. The apparatus as claimed in claim 3, wherein if said audio coding mode is a compression coding system, the encoding unit determines a maximum number of said audio channels by the following Eq. 2:

Eq. 2

$$N = \frac{Mby * Ccy}{Fs * Qb},$$

7 wherein F_s is the sampling frequency(Hz), Q_b is the quantization
8 bit number, M_{br} is the maximum data transfer rate(Mbps) of the
9 DVD-Audio disk, C_{cy} is a compression ratio according to a DTS
10 compression coding system and N is the maximum number of said
11 audio channels determined by data transfer rate, sampling
12 frequency and quantization bit number of the DVD-Audio disk.

1 6. The apparatus as claimed in claim 3, wherein if said
2 audio coding mode is linear pulse code modulated (PCM) audio, the
3 encoding unit determines said first to third quantization bit
4 numbers to be respectively 16bits, 20bits and 24bits, said first
5 to third sampling frequencies to be respectively 44.1KHz, 88.2KHz
6 and 176.4KHz, a maximum number of said audio channels is 8, and
7 the number of said channels by the following equation:

$$N = \frac{M_{br}}{F_s * Q_b};$$

8
9 wherein,

10 F_s is the sampling frequency (Hz) of the data to be
11 reproduced, Q_b is the quantization bit number (bits) of the data
12 to be reproduced, M_{br} is a maximum data transfer rate (Mbps) of
13 the DVD-Audio disk, N is a maximum number of recording channels
14 as determined by the maximum data transfer rate, sampling
15 frequency and quantization bit number of the DVD-Audio disk.

1 7. The apparatus as claimed in claim 3, wherein if said
2 audio coding mode is pseudo lossless compression coding, the
3 encoding unit determines said first to third quantization bit
4 numbers of the data to be reproduced before compression to be
5 respectively 16bits, 20bits and 24bits, said first to third

6 sampling frequencies to be respectively 44.1KHz, 88.2KHz and
7 176.4KHz, a maximum number of said audio channels to be 8, and
8 the number of said channels is determined by the following
9 equation:

$$N = \frac{Mbr * Ccr}{Fs * Qb};$$

11 wherein,

12 Fs is the sampling frequency (Hz) of the data to be
13 reproduced, Qb is the quantization bit number (bits) of the data
14 to be reproduced, Mbr is a maximum data transfer rate (Mbps) of
15 the DVD-Audio disk, Ccr is a compression ratio according to a DTS
16 compression coding system, and N is a maximum number of recording
17 channels determined by the maximum data transfer rate, sampling
18 frequency and quantization bit number of the DVD-Audio disk.

8. The apparatus as claimed in claim 3, wherein said
encoding unit stores said data on the DVD-Audio in a plurality of
audio streams, wherein said audio streams are linear PCM audio
streams or compression coded audio streams using a corresponding
extension algorithm.

9. An apparatus for recording data on a DVD-Audio disk and
a DVD-Video disk, the apparatus comprising:

an encoding unit to generate said data to be reproduced and
information on said data to be reproduced; and

an optical pickup to store said data to be reproduced in a
data zone of said DVD-Audio disk and to store said information in
an information zone of said DVD-Audio disk, said information zone
includes directories of a video title set (VIDEO_TS) and an audio

9 title set (AUDIO_TS), wherein said AUDIO_TS directory includes
 10 information on an audio manager (AMG) having information on audio
 11 titles, wherein said data zone includes said audio titles each
 12 having audio title set information (ATSI) followed by a plurality
 13 of contiguous audio objects (AOBs), said ATSI includes a
 14 plurality of audio stream attributes each having an audio coding
 15 mode, a first, second or third quantization bit number
 16 corresponding to the data to be reproduced, a first, second,
 17 third, fourth, fifth or sixth sampling frequency corresponding to
 18 the data to be reproduced, and decoding algorithm information
 19 relating to a number of audio channels of the data to be
 20 reproduced, and each of said AOBs includes a plurality of audio
 21 packs recorded with audio data corresponding to the decoding
 22 algorithm stored in the audio stream attribute, and said optical
 23 pickup storing video data in a data zone of said DVD-Video disk.

10. The apparatus as claimed in claim 9, wherein said
 encoding unit stores said data on the DVD-Audio in a plurality of
 audio streams, wherein said audio streams are linear PCM audio
 streams or compression coded audio streams using a corresponding
 extension algorithm.

11. The apparatus as claimed in claim 9, wherein if said
 audio coding mode is linear pulse code modulated (PCM) audio, the
 encoding unit determines a maximum number of said audio channels
 by the following Eq. 1:

Eq. 1

$$N = \frac{Mby}{Fs * Qb},$$

7 wherein F_s is the sampling frequency(Hz), Q_b is the quantization
8 bit number, M_{by} is the maximum data transfer rate(Mbps) of the
9 DVD-Audio disk, and N is the maximum number of said audio
10 channels determined by the data transfer rate, sampling frequency
11 and quantization bit number of the DVD-Audio disk.

1 12. The apparatus as claimed in claim 9, wherein if said
2 audio coding mode is a compression coding system, the encoding
3 unit determines a maximum number of said audio channels by the
4 following Eq. 2:

5 Eq. 2

$$N = \frac{M_{by} * C_{cy}}{F_s * Q_b},$$

6 wherein F_s is the sampling frequency(Hz), Q_b is the quantization
7 bit number, M_{by} is the maximum data transfer rate(Mbps) of the
8 DVD-Audio disk, C_{cy} is a compression ratio according to a DTS
9 compression coding system and N is the maximum number of said
10 audio channels determined by data transfer rate, sampling
11 frequency and quantization bit number of the DVD-Audio disk.

1 13. The apparatus as claimed in claim 9, wherein if said
2 audio coding mode is linear pulse code modulated (PCM) audio, the
3 encoding unit determines said first to third quantization bit
4 numbers to be respectively 16bits, 20bits and 24bits, said first
5 to third sampling frequencies to be respectively 44.1KHz, 88.2KHz
6 and 176.4KHz, a maximum number of said audio channels is 8, and
7 the number of said channels by the following equation:

$$N = \frac{M_{br}}{F_s * Q_b};$$

9 wherein,

10 Fs is the sampling frequency (Hz) of the data to be
11 reproduced, Qb is the quantization bit number (bits) of the data
12 to be reproduced, Mbr is a maximum data transfer rate (Mbps) of
13 the DVD-Audio disk, N is a maximum number of recording channels
14 as determined by the maximum data transfer rate, sampling
15 frequency and quantization bit number of the DVD-Audio disk.

1 14. The apparatus as claimed in claim 9, wherein if said
2 audio coding mode is pseudo lossless compression coding, the
3 encoding unit determines said first to third quantization bit
4 numbers of the data to be reproduced before compression to be
5 respectively 16bits, 20bits and 24bits, said first to third
6 sampling frequencies to be respectively 44.1KHz, 88.2KHz and
7 176.4KHz, a maximum number of said audio channels to be 8, and
8 the number of said channels is determined by the following
9 equation:

$$N = \frac{Mbr * Ccr}{Fs * Qb};$$

10 wherein,

11 Fs is the sampling frequency (Hz) of the data to be
12 reproduced, Qb is the quantization bit number (bits) of the data
13 to be reproduced, Mbr is a maximum data transfer rate (Mbps) of
14 the DVD-Audio disk, Ccr is a compression ratio according to a DTS
15 compression coding system, and N is a maximum number of recording
16 channels determined by the maximum data transfer rate, sampling
17 frequency and quantization bit number of the DVD-Audio disk.
18

1 15. An apparatus to record audio data and control
2 information of said audio data on a DVD, the apparatus
3 comprising:

4 an encoding unit to generate said audio data and said
5 control information of said audio data; and

6 an optical pickup to record the audio data and the control
7 information in an audio directory of the DVD.

1 16. The apparatus as claimed in claim 15, wherein said
2 encoding unit samples said audio data at a sampling frequency of
3 one of 176.4KHz and 192KHz.

1 17. An apparatus to record audio data on a DVD, comprising:
2 an encoder to encode the audio data; and
3 an optical pickup to record the audio data, audio titles
4 each having an audio title set management table followed by a
5 plurality of contiguous audio objects, a plurality of audio
6 stream attributes each having an audio coding mode, a
7 quantization bit number, a sampling frequency and decoding
8 algorithm information relating to a number of audio channels of
9 said audio data on the DVD, wherein each of said audio objects
10 includes a plurality of audio packs having portions of said audio
11 data corresponding to said decoding algorithm stored in said
12 audio stream attribute.

1 18. The apparatus as claimed in claim 17, wherein each of
2 said audio packs comprises:

3 a pack header;

4 a packet header;

5 a sub-stream identification value;

6 stuffing frame information;
7 audio frame information; and
8 one of said portions of said audio data.

1 19. The apparatus as claimed in claim 18, wherein said pack
2 header is 14 bytes, said packet header is 1 byte, said sub-stream
3 identification value is 1 byte, said stuffing frame information
4 is 1 byte, said audio frame information is 3 bytes, and said one
5 portion of said audio data is between 1 and 2013 bytes of linear
6 pulse code modulated (PCM) data.

1 20. The apparatus as claimed in claim 17, wherein each of
2 said audio packs comprises:
3 a pack header;
4 a packet header;
5 a sub-stream identification value;
6 audio frame information; and
7 one of said portions of said audio data.

1 21. The apparatus as claimed in claim 20, wherein said pack
2 header is 14 bytes, said packet header is 1 byte, said sub-stream
3 identification value is 1 byte, said audio frame information is 3
4 bytes and said one portion of said audio data is between 1 and
5 2016 bytes of Dolby AC-3 data.

1 22. The apparatus as claimed in claim 17, wherein each of
2 said audio packs comprises:
3 a pack header;
4 a packet header; and
5 one of said portions of said audio data.

1 23. The apparatus as claimed in claim 22, wherein said pack
2 header is 14 bytes, said packet header is 1 byte, and said one
3 portion of said audio data is between 1 and 2020 bytes of MPEG
4 data.

1 24. The apparatus as claimed in claim 17, wherein each of
2 said audio packs comprises:
3 a pack header;
4 a first packet header for a main audio frame;
5 a first one of said portions of said audio data in said main
6 audio frame;
7 a second packet header for an extension audio frame; and
8 a second one of said portions of said audio data in said
9 extension audio frame.

1 25. The apparatus as claimed in claim 24, wherein said pack
2 header is 14 bytes, said first packet header is 1 byte, said
3 first portion of said audio data is between 1 and 1152 bytes of
4 MPEG data, said second packet header is 1 byte, and said second
5 portion of said audio data is between 1 and 1584 bytes of MPEG
6 data.

1 26. The apparatus as claimed in claim 17, wherein each of
2 said audio packs further comprises a padding packet which is
3 increased based upon a number of samples of said audio data.

1 27. The apparatus as claimed in claim 17, wherein said
2 sampling frequency is approximately 48 KHz, said quantization bit

number is 24 bits, and said number of audio channels is 10, when said audio data is linear pulse code modulated (PCM) data.

28. The apparatus as claimed in claim 17, wherein a compression rate of said audio data is approximately 2:1 for lossless psychoacoustic coding and approximately 4:1 for lossless pseudo psychoacoustic coding.

29. An apparatus for storing audio information on a DVD-Audio disk, the apparatus comprising:

an encoder to encode the audio information; and

an optical pickup to record the audio information in both video and audio directories of the DVD-Audio disk so that both of said video and audio directories contain only audio information.

30. A method of recording data and information on said data on a DVD-Audio disk, the method comprising:

encoding the data and the information on said data; and

recording the data in a data zone of the DVD-Audio disk and recording the information on said data to be reproduced in an information zone of the DVD-Audio disk, said information zone includes directories of a video title set (VIDEO_TS) and an audio title set (AUDIO_TS), wherein said AUDIO_TS directory includes information on an audio manager (AMG) having information on audio titles, wherein said data zone includes said audio titles each having audio title set information (ATSI) followed by a plurality of contiguous audio objects (AOBs), said ATSI includes a plurality of audio stream attributes each having an audio coding mode, a first, second or third quantization bit number corresponding to the data to be reproduced, a first, second,

16 third, fourth, fifth or sixth sampling frequency corresponding to
17 the data to be reproduced, and decoding algorithm information
18 relating to a number of audio channels of the data to be
19 reproduced, and each of said AOBs includes a plurality of audio
20 packs recorded with audio data corresponding to the decoding
21 algorithm stored in the audio stream attribute.

1 31. A method of recording data and information on said data
2 on a DVD, the method comprising:

3 encoding the data and the information on said data; and
4 recording the data in a data zone of the DVD and recording
5 the information on said data to be reproduced in an information
6 zone of the DVD, said information zone storing directories of a
7 video title set (VIDEO_TS) and an audio title set (AUDIO_TS),
8 wherein said AUDIO_TS includes information on an audio manager
9 (AMG) which stores information on audio titles and said VIDEO_TS
10 includes information on a video manager (VMG) which stores
11 information on video titles.

1 32. A method of recording audio data and information on the
2 audio data on a DVD-Audio and a DVD-Video, the method comprising:

3 encoding the audio data at a sampling frequency of one of
4 176.4 KHz and 192KHz and the information on the data; and
5 recording the data and the information on the data in an
6 audio directory of the DVD.

1 33. A method of recording audio data and information on the
2 audio data on a DVD-Audio and a DVD-Video, the method comprising:

3 encoding the data at a sampling frequency of one of 176.4
4 KHz and 192KHz and the information on the data if the DVD is a

5 DVD-Audio and encoding the data at a sampling frequency of one of
6 88.2KHz and 96KHz and the information on the data if the DVD is a
7 DVD-Video; and

8 recording the data and the information on the data in an
9 audio directory of the DVD if the DVD is the DVD-Audio, and
10 recording the data and the information on the data in a video
11 directory of the DVD if the DVD is the DVD-Video.

1 34. A method of recording data and information on the data
2 on a DVD, the method comprising:

3 encoding the data at a sampling frequency of 192KHz and the
4 information on the data;

5 dividing the encoded data into data of 96KHz and data of
6 192KHz; and

7 recording the data of 192KHz as audio titles in an AUDIO_TS
8 directory of the DVD and recording the data of 96KHz as video
9 titles in a VIDEO_TS directory.

1 35. The method of claim 34, wherein the encoding comprises
2 encoding the data by linear PCM lossless encoding.

add 2C3